
T ANALYSIS OF THE LIVESTOCK AUCTION MARKETS IN WEST VIRGINIA
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SUMMARY AND CONCLUSIONS

The growth pattern of the West Virginia livestock auction sector is similar to that experienced nationally. Peak numbers of auction markets occurred in the 1950's; since that time, there has been a decline in the number of firms. Operating as auction market businesses do, on a competitive basis, it appears likely that a long-run market equilibrium must be achieved at the expense of the less efficient firms. The central problem area of this study was concerned with the estimation of costs per unit of market turnover for different size livestock auction firms in West Virginia. The statistical description method was used to determine the appropriate cost curves for an aggregate of markets in the State with the objective of ascertaining the most efficient size range in terms of cost, **ceteris paribus.**

During each of the two years encompassed by this study (1967 and 1968), there was a total of 20 livestock auctions operating as public markets in West Virginia. This study was based upon available data from the annual reports of individual auction markets as submitted to the State Department of Agriculture.

A regression equation was used to derive a livestock marketing unit ratio of 1 cattle:3 calves:4 hogs:5 sheep or lambs, which allowed the conversion of heterogeneous species into common livestock marketing units (LMU's), on the basis of the contribution of each species to market costs. Average costs were obtained by dividing total auction market costs by the number of livestock marketing units handled by a firm in a given year. Results indicated that mean average costs for firms handling less than 6,000 LMU's were $4.70 per LMU; for firms handling between 6,000 and 11,999 LMU's, mean average costs were $3.83 per LMU; and for firms of 12,000 LMU's and over, mean average costs were $3.59 per LMU. These apparent economies of size were verified by means of direct statistical analysis of market costs which indicated significant cost economies occurred as volume increased toward 6,000 LMU's per annum. Beyond this point cost economies were not as great, though smaller unit cost advantages did accrue with increasing firm size.

The study indicated the major cost component for all markets was that of labor. The data available for West Virginia auction firms showed that labor costs of $2.36 per LMU constituted, in aggregate, some 58 per cent of total unit costs ($4.09 per LMU). By contrast, unit maintenance and repair costs (9 cents per LMU)

constituted a relatively small proportion of total unit costs, a together with the small cost fraction (less than one per cent) a signed to capital improvement, indicated the reluctance of aucti operators to commit funds to the expansion of market faciliti In fact, auction markets, due to the specialized nature of oper tions and a tendency towards asset fixity are conceivably the position where they will resist liquidation so long as revenu exceed variable market costs. As time progresses, it seems like that the less efficient firms will be forced out of business. Ho ever, such a decrease in the number of firms is not necessar in accord with the needs of the various groups presently usi the auction services. The needs of farmers, for instance, are som what in conflict with the needs of packers and order buyers. Whe the latter groups would prefer fewer and larger auctions th would enable them to obtain livestock in large uniform lots fro one source, farmers would frequently choose to have access competitive market outlets, well located with reference to t point of livestock production.

Extreme seasonality in the volume of livestock marketi was demonstrated in the study, and this phenomenon was ma fested in the problem of under-utilization of plant capacity. Sin an auction firm must have sufficient facilities to handle the ma mum seasonal turnover, under-utilization of facilities occurs d ing the off-season which comprises about nine months of the ye

It appears then, that those firms handling more than 6,0 LMU's per annum enjoy distinct cost advantages over the smal firms in West Virginia. Furthermore, it appears that under con tions of increased capacity utilization, a downward shift of t long-run average cost curve would be likely. These generaliz findings suggest potential areas for decreasing costs. Some m sures which could decrease costs in the industry include:

1. increasing livestock marketing volume in the State adjusting the mix between firms of existing volumes take advantage of economies of size;
2. increasing the level of competition between firms adjusting the regulation of commission fees and all ing more than one sales day per week per firm; and
3. an increase in economic and physical efficiency of industry which could result from fewer and larger firms more efficiently located, i.e., more efficient allocation human and capital resources.

These measures are easier described than implemented. They are relatively long term means of correcting contemporary problems. They can be effective as cost-reducing measures, but a cost reduction is only effective when there is no corresponding reduction in price or gross revenue.

Increasing the number of livestock marketed through auctions may come about by increasing total production in the State or by improving the economic perspective of auction markets relative to other channels of marketing. Allowing competition to seek its own level (by relaxing government control of auction pricing and sales practices) may be one means of improving the economic perspective of some auction facilities. Allowing competition to increase may also have the effect of more efficiently allocating the human and capital resources of the auction sector. An improved State highway system (now under construction) is another important factor which could have this effect.

The three measures suggested above are interrelated and the feasibility of implementing one or more of them may be questionable under the present institutional framework of the State. It is also fairly safe to assume, that based on the trends in the industry towards fewer, larger, and more efficient firms, that the suggested improvement will come about over time at least partially without any external form of intervention.

However, an improvement in the livestock auction sector at this time may improve the relative strength of the State livestock industry as a whole. The measures suggested in this study could initially improve the economic position of some individual auction market operators. With fewer and larger auction markets, then, revenues to livestock producers could increase. Lot sizes would be larger, attracting more buyers, and in some cases, larger lot sizes of uniform animals bring higher prices. These higher prices could, however, be attenuated by higher assembly costs (from farm to the auction market) since the reduced number of auction markets would be more widely dispersed.

It can be deduced from these conclusions that the actual effects on the industry of the implementation of one or more of the above measures are not known with certainty. In order to rectify this situation, research is now underway to determine more specifically what the actual economic situation is and how to improve it.

A Cost Analysis of the Livestock Auction Markets in West Virginia

E. MACLELLAN WILSON and JOHN P. KUEHN

The historical evolution of the U. S. economy has been asso-ated with a parallel and interrelated development of the Nation's estock sector. During the frontier period, railroads came to minate the transportation scene, and indeed the rapid en-oachment of the "iron horse," catalyzed partly by the American vil War, provided a climate conducive to the establishment of rge terminal markets at strategic points in the Midwest.[1] During e latter half of the nineteenth century, stockyards opened in icago (1865), Kansas City (1871), St. Louis (1872), Cincinnati 874), Indianapolis (1877), Omaha (1884), Denver (1886), St. ul (1888), Fort Worth (1893), Sioux City (1894), and St. seph (1896).[2] However, the ensuing system of livestock market-g was tied to the rails and in this respect exhibited a certain gree of inflexibility.

Williams and Stout have suggested three reasons that prompt-the move away from centralized marketing:

1. less-than-carload freight rates that the individual farmer found prohibitive,
2. complaints of low livestock prices, and
3. the suspicion that dealer operating margins were unjustifiably wide.[3]

anges in the marketing structure gained momentum in the rly part of the twentieth century. Williams and Stout state:

> Out of World War I came the truck, a war-tested vehicle of unforseeable usefulness and significance. Other developments were to come: automobiles; a network of roads and highways; a growing population; growing cities that spread and enveloped terminal stockyards once located on the out-skirts; thriving retail grocery chains and supermarkets—a totally new concept in self service—. . .[4]

[1]For a more complete discussion of the historical development of the livestock-at industry see Willard F. Williams and Thomas T. Stout, **Economics of the estock-Meat Industry** (New York: The Macmillan Company, 1964), ch. 1.
[2]Edward Uvacek and Dalton L. Wilson, **Livestock Terminal Markets in the ited States.** Agricultural Marketing Service, U. S. Department of Agriculture, rketing Research Report No. 299 (Washington: U. S. Government Printing ice, 1959), p. 2.
[3]Williams and Stout, **op. cit.**, p. 22.
[4]**Ibid.**, p. 24.

Thus the 1930's witnessed a dynamic growth in the numb of livestock auction markets. Phillips and Engelman have not that:

> About 200 auctions are estimated to have been operating by 1930. The first complete count made in 1937 indicated 1,345 auctions were operating in the United States. Another count showed 2,472 operating in 1949. The peak in numbers was reached in 1952 when over 2,500 different livestock auctions were holding sales. Another complete count in 1955 showed that auction numbers had declined to 2,322.[5]

A similar pattern of growth occurred for West Virgin auctions. Abrahamsen recorded that: "the first auction to organized was the Spencer Livestock Exchange, chartered Fe ruary 11, 1932."[6] In 1956 another study indicated that: "sixte of West Virginia's auctions were organized in the period 193 1938. Six were established in the 1940's, and the last one in 1950 Thus by 1950 there was a total of 23 auctions operating in t State, although in 1968 this number had declined to 20 (Append Table 1), and in 1969 one additional market closed down. A appropriate description of the growth characteristics exhibit by West Virginia's livestock auctions emerges from the c servation that:

> The first sign of a new industry is its inception period followed by a period of rapid growth, both in numbers and capacity. Following this rapid expansion is the leveling off period as demand for their services is fulfilled. Finally, a decline in the number of firms materializes as low volume firms with high unit costs cease to exist as competition between firms for the available market increases.[8]

During the 1960's the decline in the number of auction m kets in the State was accompanied by a concurrent decline in volume of marketings (Table 1) and in the farm inventory of li stock (Table 2). Table 1 shows, for example, that in the ye

[5]Victor B. Phillips and Gerald Engelman, **Market Outlets for Livestock P ducers,** Agricultural Marketing Service, U. S. Department of Agriculture, Mar ing Research Report No. 216 (Washington: U.S. Government Printing Of 1958), p. 8.

[6]M. A. Abrahamsen, **Livestock Marketing Agencies in West Virginia,** W Virginia Agricultural Experiment Station, Bulletin 312 (Morgantown, Decem 1943), p. 57.

[7]C. G. Randell, **Livestock Auctions in the Northeastern States,** U. S. Dep ment of Agriculture, Farmer Cooperative Service Bulletin 8 (Washington: U.S Government Printing Office, 1956), p. 11.

[8]R. C. Lindberg and G. G. Judge, **Estimated Cost Functions for Oklaho Livestock Auctions,** Oklahoma Agricultural Experiment Station, Bulletin B (Oklahoma State University, January, 1958), p. 7.

TABLE 1

LIVESTOCK MARKETED THROUGH WEST VIRGINIA AUCTIONS, BY CLASS: 1961-1968[a]

Year	Cattle and Calves	Hogs	Sheep and Lambs
1961[b]	252,705	64,553	167,702
1962	265,201	71,799	163,179
1963	264,137	69,618	147,819
1964	258,195	61,528	125,845
1965	270,523	51,883	121,194
1966	234,332	56,112	117,488
1967	192,396	54,880	112,431
1968	197,444	55,044	108,476
1961-1965 Average	262,152	63,876	145,147
1968 as % of 1961-1965 Average	75.32	86.17	74.74

[a] Source: From Annual Reports of Livestock Auction Markets to the West Virginia Department of Agriculture, 1961-68.
[b] 6 markets out of 22 did not report.

TABLE 2

LIVESTOCK INVENTORY, WEST VIRGINIA, BY NUMBER ON HAND JANUARY 1, 1961-1968[a]

Year	Cattle and Calves	Hogs	Sheep and Lambs
1961	535,000	95,000	275,000
1962	530,000	83,000	256,000
1963	514,000	82,000	241,000
1964	504,000	73,000	214,000
1965	494,000	62,000	205,000
1966	459,000	54,000	191,000
1967	427,000	60,000	178,000
1968	448,000	62,000	173,000
1961-1965 Average	515,000	79,000	238,000
1968 as % of 1961-65 Average	86.99	78.48	72.69

[a] Source: 1961-1967 data from West Virginia Department of Agriculture, **1968 West Virginia Agricultural Statistics**, West Virginia Crop Reporting Service, C. R. Bulletin No. 7 (Charleston: February, 1968), pp. 17, 19, and 20. Data for 1968 were from United States Department of Agriculture, **Livestock and Poultry Inventory, January 1: Number, Value, and Classes**, Crop Reporting Board, Statistical Reporting Service, U. S. Department of Agriculture (Washington: U. S. Department of Agriculture, February, 1969), pp. 9, 10, and 14.

1966, 1967, and 1968, as compared with a 1961-1965 average, the was a decrease in the numbers of the main classes (cattle an calves, hogs, and sheep and lambs) disposed through auctio sales. For the ruminant members of these main classes, the 19(figure was some 25 per cent below the 1961-1965 average, ar for hogs the 1968 figure was nearly 14 per cent below the 1961-19(average. The inventory of livestock on West Virginia farms di played a similar decline. Thus in Table 2, the 1968 figure f numbers on hand expressed as a percentage of the 1961-1965 ave age was 86.99 for cattle and calves, 78.48 for hogs, and 72.69 f sheep and lambs. Data are available which confirm the downwa secular trend for hogs, and for sheep and lambs over a mu longer period, but these data also indicated that cattle and c production experienced a generally rising trend up to the 1960 This inconsistency, with respect to cattle and calves in the yea 1966, 1967, and 1968, may well be explained as a cyclical phenoenon.

STATEMENT OF THE PROBLEM

The decline in numbers of livestock auction markets op ating in West Virginia during the 1960's reflected an era of creased competition for the available market.[9] This decline lea one to suspect that there is an excess of firms in the livestc marketing sector under present conditions. The objective of t study was to evolve a broad economic sketch of livestock auctio in West Virginia in terms of relationships between the ann marketing volumes and unit costs; to relate this relationship o the theoretical notion of economies of size; and to evaluate selt ed institutional variables for different size firms. Specific o jectives were:

1. to evolve livestock species conversion coefficients wh could be used to rank different sized auctions on a hoo geneous base,
2. to estimate the statistical parameters which appro mate appropriate unit cost functions.

[8]Secular trends for the period 1867 to 1954 may be found in W. S. H **Livestock Marketing Practices of West Virginia Farmers.** West Virginia versity Agricultural Experiment Station, Bulletin 384 (Morgantown, Dec 1955), pp. 6-8. For data through 1960 see Mary E. Templeton, **Statistical Ch book of West Virginia Agriculture.** West Virginia Agricultural Experiment tion, Current Report 51 (Morgantown, March, 1967), pp. 12 and 16.

[9]One market ceased operation in 1965, one in 1966, and one in 1969.

3. to examine the hypothesis that cost economies will be found within the range of different sized markets, and
4. to discuss the influence of relevant institutional variables on operational efficiency.

RESEARCH METHOD AND SOURCE OF DATA

The statistical description method was used to accomplish the objectives of this study. Cross section data for two years (1967-1968) were used to yield a broad cost-volume relationship for the livestock auctions of the State.

The primary source of data for this study was the 1967 and 1968 Annual Reports of West Virginia livestock auction markets to the Commissioner of Agriculture in Charleston. Auction operators are required by law to submit business records to the State Department of Agriculture each year. These records include information on livestock volume turnover by species for each sale, and cost figures by specified categories per annum. Supplementary information was obtained from existing literature on livestock marketing, and from direct liaison with local representatives of the State Department of Agriculture and with members of the Cooperative Extension Service of West Virginia University who maintain close contact with individual auction firms.

LIVESTOCK MARKETING RESEARCH IN WEST VIRGINIA

At the time of this study, there was a limited amount of up-to-date information on livestock auction markets in West Virginia. There were, however, a few studies which provided some data information on the historical evolution of the industry. Abrahamsen, for instance, conducted an extensive survey of the "operating practices followed by livestock marketing agencies in West Virginia."[11] In discussing the operating statements of a sample of the auction firm population, he noted that:

> The larger auctions returned about one-half cent more per dollar of sales to consignors and operated at a cost of about one-half cent less per dollar of sales. Net income was 0.71 cents per dollar of total sales for the larger auctions as compared with 0.46 cents for the smaller ones.[12]

[11] M. A. Abrahamsen, **Livestock Marketing Agencies in West Virginia,** West Virginia Agricultural Experiment Station, Bulletin 312 (Morgantown, December, 19).

[12] **Ibid.,** p. 73. Size of auctions in terms of annual dollar sales.

With regard to expense items, this study also indicated that:

> Wages, bonuses, and salaries accounted for approximately one-half of total expenses. Officers' and directors' salaries accounted for another one-tenth of total expenses, making a combined total of about 60 percent of the total expenses for all salaries and wages. Except for taxes, the next most important item was operating and trading loss. . . It is significant that in practically every instance, auctions lost money on their trading operations. This does not mean, however, that persons connected with auctions lost money when operating as individuals."

A subsequent study by Hutson investigated "the livestock marketing practices of West Virginia farmers."[14] While it would be naive to assume that the situation has been static over the last two decades, it is of interest that in 1950 a sample survey by Hutson indicated that: "approximately two-thirds of the cattle and calves, slightly more than one-half of the hogs and pigs, and two-thirds of the sheep and lambs marketed from West Virginia farms were sold through auctions."[15] This study also underlined the seasonal nature of livestock marketing by tracing seasonal fluctuations in volume. For sheep, where the largest variation occurred, the study showed "90 percent of the reported sales concentrated in July, August, September, and October."[16]

CHARACTERISTICS OF AUCTION MARKETS IN WEST VIRGINIA

Auction Ownership

In each of the two study years, 1967 and 1968, there were 19 livestock auctions in West Virginia. Classified by type of business ownership, 17 firms were organized as corporations. Of the remaining, one firm operated on an individual proprietorship basis, one as a partnership, and one as a cooperative enterprise. Under the terms of the statutory provisions of West Virginia, an annual permit was required to operate a public market regardless of type of ownership.[17] Furthermore, before the permit could

[13] **Ibid.**, pp. 75-76.
[14] W. S. Hutson, **Livestock Marketing Practices of West Virginia Farmers**, West Virginia University Agricultural Experiment Station, Bulletin 384 (Morgantown, December, 1955).
[15] **Ibid.**, p. 3.
[16] **Ibid.**, p. 25.
[17] West Virginia Department of Agriculture, **Laws of West Virginia Relating to Agriculture and Veterinarians** (Charleston: West Virginia Department of Agriculture, 1965), p. 9, reprinted from Michie's West Virginia Code of 1961 and 1965 Cumulative Supplement.

t issued, a surety bond payable to the State for the security of c nsignors was necessary.[18]

A ction Market Facilities[19]

The design of individual markets varied throughout the S ate, though all markets had the essentials for normal selling o erations. These include a dock for receiving and loading, a sys- t n of pens and alleys for handling livestock, weighing facilities, g ading and testing pens with a catching chute, sheep dipping f ilities, watering facilities, office facilities, a sales room, and f ilities for the public (rest rooms and drinking water supply). A ditional features included some sort of food and refreshment s vice for the public, but restaurant facilities varied in sophisti- c ion from market to market.

R ceiving and Loading Facilities

Most West Virginia auction markets used the same docks for r eiving livestock and loading after sales. Generally speaking, t se facilities were adequate to handle the normal volumes of l stock expected by markets. Although most livestock markets i the State have close access to railway facilities, this means of d ivery and removal of livestock had been virtually replaced by t ck transportation. Access roads were adequate to cope with t ck traffic. However, the completion of the interstate high- w y system in West Virginia should greatly expedite movement o livestock.

P s and Alleys

Due to the seasonal nature of livestock marketing, auction n nagement is faced with the dilemma of providing adequate y d facilities for peak sales periods, commensurate with overall e ciency in off-peak seasons. In West Virginia auction markets, t pen facilities were well used in the fall, and only partially f d for the rest of the year. Pens were generally constructed o wood, and four of the markets in the State had overhead walk- w ys for the benefit of prospective buyers.

H ndling and Care of Livestock Before Sale

Auction markets in West Virginia were required by law to

[18] Ibid., p. 10.

[19] Unless footnoted otherwise, the material presented under this heading was o ined from personal interview with Joseph C. Emch, State Extension Specialist- A nal Husbandry, and Noah E. Perry, Chief of the Livestock Section, West Vir- s a Department of Agriculture.

employ a licensed weighman, a licensed grader, and a licensed auctioneer at every sale.[20] Weighing facilities were supervised by representatives of the State Department of Agriculture and the State Department of Labor. All official grading, sorting, and classifying was conducted by the State Department of Agriculture with fees for this service being charged to the auction. The Cooperative Extension Service complemented this service for the duration of the special feeder calf sales in the fall. Feeding and watering facilities were available at all markets. It was believed that these facilities could have been improved.

Sales Room

The sales room for all auctions consisted of a ring, a booth for the auctioneer and attendants, and seating space for the public. Typically, the sales room was organized as a U-shaped amphitheater, with wooden or concrete stadium-type seats allowing the public an unrestricted view of the ring and auctioneer.

Sale Characteristics

Regular sales were held once a week at all markets (Appendix Table 1) and commenced between 1 and 2 p.m. on the assigned day. The length of the sale varied considerably with the season, but generally ended about 6 p.m. Generally speaking, there was no rigid order of selling the different classes of livestock. The order of selling was instead left flexible to suit buyers and auction personnel. Bidding characteristics were consistent with normal auction procedures; each consignment or lot being sold on its merits to the highest bidder. Communication between the auctioneer and buyers followed established patterns. Auctions allowed the seller to "pass out" (cancel the sale of his consignment if the price was not acceptable to him, providing his livestock was not in a co-mingled lot. Buyers were warned of defective consignments with the phrase "sold as is." Major buyer participation at these sales appeared to come from farmers, packers, and other buyers. The relative importance of any one buyer group appeared to vary with the season. However, an accurate appraisal of this variation was not possible. All financial settlements were cleared through the auction office within the time limit designated by

[20]Laws of West Virginia Relating to Agriculture and Veterinarians, op. cit., p. 10.

ıe Packers and Stockyard Act, but usually directly after each ıle.[21]

LIVESTOCK AUCTION COSTS

Data for this study were obtained from the 1967 and 1968 ınnual Reports of West Virginia livestock auction markets as ıbmitted to the Commissioner of Agriculture in Charleston. hese records contained complete livestock volume data for all of ıe 20 markets in each of the study years. However, one respon- ent in 1967 and three respondents in 1968 had omitted the cost ction of the State Department of Agriculture questionnaire. For an example of this questionnaire, see Appendix Table 2).

Data for the two study years (1967-1968) were averaged ıd classified under the following sub-headings:

1. Labor costs. These include officers and executive salaries, management and supervision salaries, office salaries (clerical), wages, and the auctioneer's salary;
2. Utilities. Include heat and fuel, light and power, water, telephone and telegraph;
3. Investment costs. Include depreciation and depletion of operating equipment, insurance and bonds, taxes, interest, and capital improvement costs;
4. Operating costs. Include repairs and maintenance of buildings, equipment, and land, office supplies (stamps, stationery and other office supplies), feed, transportation and gasoline, market news service, and lease costs;
5. Miscellaneous. Includes yard supplies, veterinary fees, medicines and vaccines, grading fees, death losses, freight charges, donations, bad debts, legal and audit fees, workmen's compensation, subscriptions and dues, and licenses (Table 3).

The largest component of total cost was that of labor (56.1 r cent). Wages were the largest element of the total labor costs, ıounting to 40.4 per cent of total labor costs and 22.7 per cent total cost. It may be recalled that Abrahamsen[22] found total ıor costs to be about 60 per cent of all total costs.

[21]Payments must be made before the close of the next business day. United ıtes Department of Agriculture, **Packers and Stockyards Act of 1921, as Amended,** :kers and Stockyards Administration, U. S. Department of Agriculture (Wash- :ton: U. S. Government Printing Office, 1967), p. 37.
[22]Abrahamsen, **op. cit.,** pp. 75-76.

Investment costs were 21.1 per cent of total cost; operatin costs were 11.7 per cent; utilities, 3.5 per cent; and miscellaneou costs, 7.6 per cent.

ESTIMATION OF LIVESTOCK CONVERSION COEFFICIENTS

Market volume data for the two study years encompassed th major livestock species, under the broad classifications of "cattle "calves," "hogs," and "sheep and lambs." Records also includ details of minor species (horses and mules, chickens, rabbits

TABLE 3

COST BREAKDOWN FOR WEST VIRGINIA LIVESTOCK AUCTIONS, AVERAGE DATA FOR 17 FIRMS IN 1967 AND 15 FIRMS IN 1968*

Unit	Dollars		Percentage of Total Costs
Labor	18,397.69	56.1	
Officers and Executives		2,895.18	8.8
Management and Supervision		1,502.37	4.6
Office Salaries		4,376.25	13.3
Wages		7,438.47	22.7
Auctioneer		2,185.42	6.7
Utilities	1,156.38	3.5	
Investment Costs	6,915.05	21.1	
Depreciation		1,829.55	5.6
Insurance and Bonds		1,769.20	5.4
Taxes		1,953.12	5.9
Interest		1,206.31	3.7
Capital Improvement Cost		156.87	0.5
Operating Costs	3,834.96	11.7	
Repairs and Maintenance		829.63	2.5
Office Supplies		1,034.45	3.2
Feed		176.92	0.5
Transportation and Gasoline		264.94	0.8
Market News Service		965.44	2.9
Lease Costs		563.58	1.7
Miscellaneous	2,489.10	7.6	
TOTAL	32,793.18		100.0

*Source: Computed from "Expenses During Year" section of the A Report of auction markets to the West Virginia Department of culture, 1967 and 1968. (Appendix Table 2).

other agricultural products (eggs, apples, hides); and, of iscellaneous merchandise (farm machinery, domestic appli-nces). Since the latter items in aggregate constituted a relatively nall proportion of total dollar turnover, and in view of the prac-cal difficulties of quantifying such a diverse range of mer-iandise, only the major livestock species—cattle, calves, hogs, id sheep and lambs—were included in this study (Tables 4 and). Livestock volume was expressed in terms of the number of ead of each species handled by an auction in one year. Total sts were computed directly from the annual State questionnaire) auction markets.

In order to proceed with the cost analysis and in order to evelop comparable unit costs for different markets, it was necess-y to convert heterogeneous livestock species to common units. ne way of accomplishing this would have been to use a con-

TABLE 4

ANNUAL MARKET COSTS AND LIVESTOCK VOLUME, BY MAJOR SPECIES, FOR 19 WEST VIRGINIA LIVESTOCK AUCTIONS, 1967[1]

Market Code	Cattle	Calves	Hogs	Sheep & Lambs	Total Costs
701	3,437	5,791	3,268	10,649	$ 27,698.34
702	12,801	4,558	5,751	14,375	57,633.90
703	6,136	6,223	15,175	2,811	47,172.32
704	11,685	3.212	639	694	49,294.84
705	5,733	3,220	534	2,052	24,115.11
706	3,021	4,348	839	2,356	33,612.33
707	1.689	634	318	2,209	9,511.70
708	2,339	1,895	610	605	14,755.44
709	1,025	834	734	2,825	10,570.06
710	2,936	1,419	331	231	15,393.90
711	5,049	4,195	1,589	1,957	27 842.56
712	1,693	3,602	837	1,582	17,716.76
713	1,187	2,679	459	18,837	20,253.17
714	9,730	3,951	3,780	524	37.464.60
715	14,325	4,300	10,781	36,863	101,334.25
716	7,737	9,043	1,394	1,524	47,426.77
717	7,538	4.538	2,565	5,109	35,943.56
718	10,211	4.994	3,081	3.681	45,945.28
719	8,697	3 005	1,378	3,338	46,889.70

ource: Derived from the 1967 Annual Reports of Livestock Auction Markets to the Commissioner of Agriculture, West Virginia Department of Agriculture, Charleston.

ventional livestock unit in which the common animal denomina tor is based on feed consumption or space requirements. Howeve such a measure would not necessarily correlate each species wit market costs and, therefore, would not contribute to the specif objectives of this analysis. A second alternative would be th of categorizing auctions according to annual dollar turnove This procedure, while giving a superficial indication of mark size, would not facilitate the development of comparable unit cos for different firms. A third alternative would center around t use of a ratio based upon auction market commission fees. Ho ever, due to the diversity of tariff schedules between auctior this measure was also rejected.

It was, therefore, decided to use multiple regression tec niques to relate the numbers of individual livestock species (ind pendent variables) to market costs (dependent variable). Th method could then be used to derive cost coefficients which wo directly applicable to West Virginia conditions. A linear multip regression model of the form:

TABLE 5

ANNUAL MARKET COSTS AND LIVESTOCK VOLUME, BY MAJOR SPECIES, FOR 17 WEST VIRGINIA LIVESTOCK AUCTIONS, 1968*

Market Code	Cattle	Calves	Hogs	Sheep & Lambs	Tota Cost
6801	3,612	6,485	2,918	10,618	$ 29,551 0
6802	12,638	4,653	5,903	12,231	93,502 7
6803	7,200	5,691	15,526	2,164	51,354 0
6804	12,144	5,092	824	752	53,313 9
6805	3,814	1,459	385	938	21,256 5
6806	2,052	556	265	1,710	14,418 0
6807	3,199	1,672	623	691	17,432 5
6808	1,014	812	582	2,823	8,27?2
6809	3,096	1,654	342	162	17,60?7
6810	4,566	3,731	1,223	1,901	27,98?6
6811	1,657	3,613	532	1,383	15,66?5
6812	1,794	2,830	302	19,622	20,87?2
6813	9,680	3 691	4,522	353	37,23?0
6814	7,046	8,234	1,053	957	46,95?4
6815	6,381	4 080	2,217	4,577	38,25?0
6816	11,415	5,107	3,276	3 363	47,63?6
6817	10,143	3,115	1 210	3 611	50,86?6

*Source: Derived from the 1968 Annual Reports of Livestock Auction M to the Commissioner of Agriculture, West Virginia Department of A culture, Charleston.

$Y = A + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$

s used where,

= Total costs per livestock auction per year;
= A positive intercept on the Y axis representing market costs when sales volume approaches zero, in other words, fixed market costs;
= The number of cattle handled in a year;
= The number of calves handled in a year;
= The number of hogs handled in a year;
= The number of sheep and lambs handled in a year.

The partial regression coefficients obtained from this model plicitly recognize the marginal market cost incident upon the e of one head of a particular species. Thus, the results can be ectly converted into coefficients for converting livestock species common units, or "livestock marketing units."[23]

Combined data from Tables 4 and 5, representing 36 observations of a two-year population of 40, were used to develop the odel.[24] A stepwise linear regression program was used (for alysis of variance of the multiple correlation coefficient see pendix Table 4)[25], which yielded the following equation:

$$Y = 1790.32 + 3.681X_1 + 1.289X_2 + 0.876X_3 + 0.769X_4$$
$$(0.349)^{**} \quad (0.679) \quad (0.371)^{*} \quad (0.173)^{**}$$
$$R^2 = .90$$

Standard errors of the estimates of the multiple regression uation are printed in parentheses below the partial regression efficients. A double asterisk denotes significance at the .01 el; a single asterisk denotes significance at the .05, but not at e .01 level. The R^2 value of .90 indicates that the four variables, , X_2, X_3, and X_4, accounted for 90 per cent of the variability ound Y. The equation suggests that for each additional head cattle marketed, total costs would increase by $3.68. For each ditional calf, the increase would be $1.29; for each hog, $.88; d for each sheep or lamb, $.77.

[23]A "livestock marketing unit" (L. M. U.) was construed in this study to n an integer constant which relates the number of head of individual species, ivalent in terms of market cost, to a base unit of one represented by "cattle."
[24]A combination of the data for two years would reduce inter-year variations he cost accounts. A statistical comparison of the means of the 1967 and 1968 a is given in Appendix Table 3.
[25]Computer program used was University of California, Biomedical Computer Program, BMDO2R, "Stepwise Regression." For a description of this program, see W. J. Dixon (ed.), **Biomedical Computer Programs,** University of California Publications in Automatic Computation No. 2 (second edition; Berkeley and Los Angeles, University of California Press, 1968), pp. 233-257.

COMPARISON OF REGRESSION COEFFICIENTS WITH ACTUAL AUCTION FEES

Public livestock markets in West Virginia were required und the provisions of the Packers and Stockyards Act to post approv "tariff sheets," or schedules of charges relating to their mark activities. Commission charges were levied at most auction ma kets on a discriminate basis against specified livestock categori classified by weight, sex, and sometimes lot size (with small lots i curring a penalty). In some cases, these commissions were i cremented by a yardage fee, normally 1.0 or 1.5 per cent of gro sales, whereas other markets listed fees inclusive of commissio and yardage. Feed charges were levied by most markets at co F.O.B. the stockyards, though some did add a percentage or a solute amount to this initial charge. Fees for veterinary inspe tions and additional services complemented the schedule.

Since the fee schedules varied for different markets in t State, both in the method of classifying livestock categories a in the magnitude of the fees, it was not possible to devise a tru representative average schedule for all markets. Nevertheless, a example of part of a fairly typical tariff sheet of a West Virgin livestock auction market is reproduced in Appendix Table 5. T fees presented in this tariff sheet, as well as could be appraise appeared to compare favorably with the regression coefficien derived in the previous section.

This comparison, therefore, appeared to support the use livestock conversion coefficients derived from regression tec niques. Livestock marketing units were computed from the parti regression coefficients by relating the number of head of t various species equivalent, in terms of total market costs, to o "cattle"—a ratio of 1 cattle:3 calves:4 hogs:5 sheep and lambs.

ANALYSIS OF COST AND VOLUME DATA

Livestock marketing units (LMU's) derived in the procedi chapter were used to rank auctions on a common size basis and compute total costs per LMU for West Virginia livestock auctio Results, tabulated in Table 6, exhibited a range in market s of over 23,000 LMU's for 19 firms in 1967, and over 12 500 LMU for 16 firms in 1968.[7] The scatter of total costs per LMU for ea of the two study years generally declined as firm size increas

[7]Cost data for the largest firm (28,710 LMU's) in 1968 were not available. second largest firm in 1968 was omitted from all cost analyses in the study to a bias in the data resulting from participation in non-market business op tions in that year.

TABLE 6

SIZE RANGE AND AVERAGE TOTAL COSTS FOR WEST VIRGINIA AUCTION MARKETS, RANKED IN ASCENDING ORDER OF LIVESTOCK MARKETING UNITS, 19 FIRMS IN 1967, 16 FIRMS IN 1968[a]

1967		1968[b]	
LMU	Cost per LMU	LMU	Cost per LMU
2,052	$5.15	1,995	$4.15
2,422	3.93	2,646	5.45
3,244	4.55	3,271	4.79
3,419	5.18	3,765	4.67
3,538	4.35	4,050	4.30
5,151	6.52	4,584	4.64
5,962	3.40	6,496	4.31
7,236	3.85	6,737	3.10
7,350	3.28	8,627	3.43
8,314	3.33	9,211	4.15
10,711	4.38	10,249	4.58
10,714	3.35	12,111	3.07
11,405	4.16	12,206	4.17
12,097	3.10	13,411	3.83
12,566	3.75	14,198	3.75
13,054	3.78	14,609	3.26
13,382	3.43		
18,633	3.09		
25,326	4.00		

[a]Source: Derived from data in Tables 4 and 5.
[b]Cost data for the largest firm (28,710 LMU's) in 1968 were not available. The second largest firm in 1968 was omitted from all cost analyses in the study due to a bias in the data resulting from participation in non-market business operations in that year.

SEASONAL VARIATIONS IN LIVESTOCK MARKETING

The problem of unused capacity is commonly encountered in livestock marketing. Seasonal variations in the numbers of various species handled by West Virginia auctions were evident in the monthly marketing data presented in Table 7. The peak sales period for the ruminants (cattle, calves, and sheep and lambs) occurred in the months of September, October, and November. By contrast, hogs maintained a relatively even market flow throughout the year. Data in Table 7 were converted to a monthly index of the two-year annual mean (equivalent to a base of 100) for each species and for total LMU's handled (Table 8). Results are illustrated graphically in Figure 1. The greatest absolute annual

TABLE 7

MONTHLY VARIATIONS IN VOLUME OF MARKETINGS, BY NUMBERS OF MAJOR SPECIES, WEST VIRGINIA LIVESTOCK AUCTIONS, 1967 AND 1968[a]

	Cattle		Calves		Hogs		Sheep & Lambs	
	1967	1968	1967	1968	1967	1968	1967	1968
January	5,722	4,331	3,605	3,106	4,163	4,331	3,246	3,027
February	3,046	3,384	2,383	2,472	3,545	4,101	956	1,870
March	4,122	5,225	3,487	3,223	4,506	5,076	1,682	1,704
April	13,651	13,549	4,092	3,631	4,669	4,746	1,106	1,514
May	5,820	5,567	4,304	3,614	5,724	4,832	1,985	1,886
June	4,747	5,421	4,823	4,321	5,266	5,043	7,224	6,338
July	5,893	6,415	5,136	4,923	4,613	5,048	12,654	12,336
August	7,388	8,258	5,411	4,732	3,473	3,594	18,145	15,793
September	14,645	18,001	9,635	6,973	4,521	3,644	21,653	21,677
October	30,699	28,976	17,795	23,210	4,677	4,547	21,719	24,960
November	17,724	20,318	8,358	7,870	5,725	5,758	17,057	13,015
December	5,392	5,111	3,017	3,076	3,998	4,324	5,004	4,356
Annual Average[b]	9,904	10,380	6,004	5,929	4,573	4,587	9,369	9,040
Average for 1967 & 1968[b]	10,142		5,967		4,580		9,205	

[a]Source: Taken from the Annual Reports of Livestock Auction Markets to the West Virginia Department of Agriculture, 1967 and 1968. Includes total market population.

[b]Rounded

ariation in numbers occurred for cattle. Calves, however, experienced the widest percentage fluctuation, reflecting the increased sales momentum of the well publicized special feeder-alf sales in October.

In terms of total LMU's, the index of monthly variation in narketings indicated that West Virginia auctions operated below the annual mean market volume for eight months in the ear. The mean market volume (Index = 100) represented a mere 6 per cent of the maximum October market volume, which suggests considerable under-utilization of plant capacity on an annual basis. This observation does not take into consideration the veek-to-week under-utilization of plant capacity resulting from he once a week sale characteristics of auctions in the State.

STRATIFIED UNIT COST COMPARISONS

Market data were divided into three size groups for purposes f investigating unit cost components. The smallest size group ncompassed all markets handling less than 6,000 LMU's per year;

TABLE 8

MONTHLY INDEX OF MARKETING VOLUME, BY MAJOR SPECIES AND LIVESTOCK MARKETING UNITS, WEST VIRGINIA LIVESTOCK AUCTIONS, 1967 AND 1968[a]

	Cattle	Calves	Hogs	Sheep & Lambs	LMU[b]
anuary	50	56	93	34	52
'ebruary	32	41	83	15	35
Aarch	46	56	105	18	48
pril	134	65	103	14	108
Aay	56	66	115	21	58
une	50	77	113	74	61
uly	61	84	105	136	76
ugust	77	85	77	184	91
eptember	161	139	89	235	162
)ctober	294	344	101	254	281
Jovember	188	135	125	163	251
)ecember	52	51	91	51	55

Source: Computed from Table 7. Monthly indices represent percentage variation from the two-year annual mean (=100). Rounded two-year annual means from Table 7 were: for cattle, 10,142; for calves, 5,967; for hogs, 4,580; and for sheep and lambs, 9,205.

Monthly indices of LMU's were obtained by converting two-year average numbers or each species into LMU's. Total monthly LMU's were expressed as indices of he two-year annual mean LMU's (15,117) represented by a base of 100.

the intermediate group ranged from 6,000 LMU's to 11,999 LMU's; and the largest size group included all firms handling over 12,000 LMU's. Cost data for individual components of total costs were used to compute costs per livestock marketing unit and results were averaged for each of the size groups specified[2] Data were obtained from records of 19 firms in 1967 and 16 firms in 1968.

Group total costs per livestock marketing unit, for a total of 35 firms in 1967 and 1968, were $4.09 (Table 9). For the small firms (below 6,000 LMU's per annum), group average total costs were $4.70; for intermediate firms (6,000 — 11,999 LMU's per annum) $3.83; and for the largest West Virginia auction firms (12,000 LMU's and over), $3.59. This decline in unit costs associated with an increase in firm size conforms to the economic theory of the firm and is reflected in most of the individual cost components shown in Table 9.

STATISTICAL ESTIMATES OF COST FUNCTIONS

The stratified unit-cost relationship was expressed graphically by using least squares techniques to fit the appropriate unit cost functions to the cost and volume data. Data for a total of 35 firms in the two study years were used. In order to reduce inter-firm cost deviations, data were grouped into eight combined size categories as shown in Table 10. A stepwise linear regression program was employed to estimate the four regression equations postulated below:

$$Y_i = A + b_1X_1 + b_2X_2 \qquad (1)$$

$$Y_i = A + b_1\left(\frac{1}{X_1}\right) \qquad (2)$$

$$\log Y_i = A + b_1 \log X_1 \qquad (3)$$

$$Y_i = A + b_1\left(\frac{1}{X_1}\right) + b_2\left(\frac{1}{X_2}\right) \qquad (4)$$

where,

Y_i = Total cost per livestock marketing unit in cents;
A = Constant term;
X_1 = Hundreds of livestock marketing units handled in a year;
X_2 = Squared value of X_1.

[2]Computer program used was University of California, Biomedical Computer Program, BMD07D, "Description of Strata with Histograms." For a description of this program, see W. J. Dixon (ed.), **Biomedical Computer Programs**, University of California Publications in Automatic Computation No. 2 (second edition; Berkeley and Los Angeles, University of California Press, 1968), pp. 95-108.

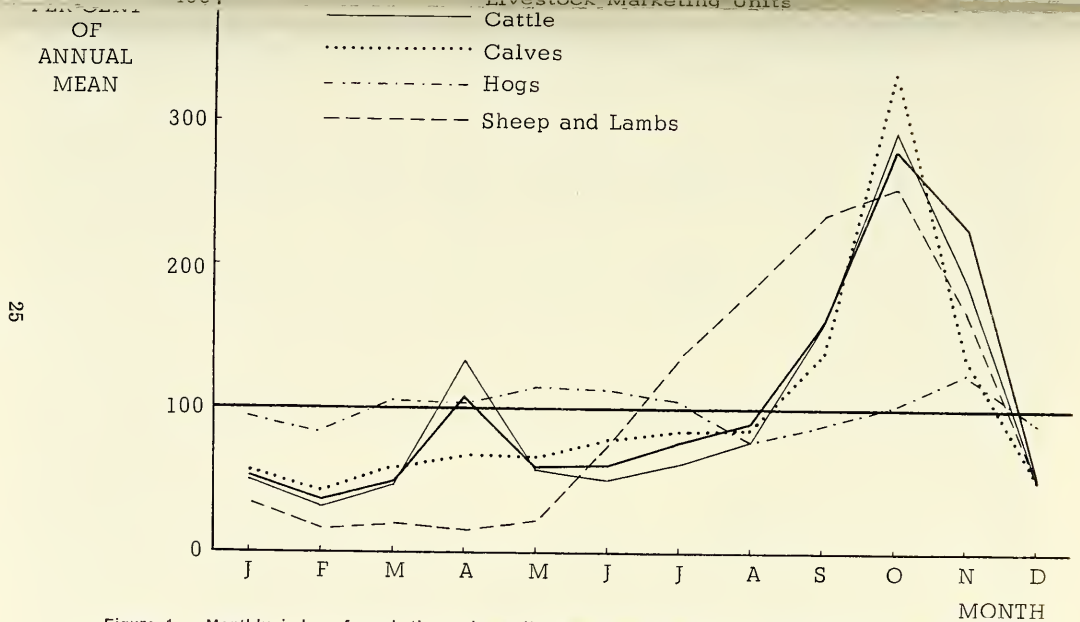

Figure 1. Monthly index of marketing volume (two-year annual mean = 100), by major species and livestock marketing units, West Virginia livestock auctions, 1967 and 1968 (From data in Tables 7 and 8).

TABLE 9

MEAN COSTS PER LIVESTOCK MARKETING UNIT FOR MAJOR COMPONENTS BY SPECIFIED FIRM SIZE GROUPS, 19 FIRMS IN 1967, 16 FIRMS IN 1968[a]

	Market Size Group in LMU's[b]			
Costs per LMU	0-5,999	6,000-11,999	12,000 or over	All Markets Combined
	Dollars per LMU			
Labor	2.90	1.97	2.11	2.36
Officers & Executives	0.40	0.28	0.40	0.36
Management & Supervision	0.35	0.04	0.16	0.20
Office Salaries	0.85	0.74	0.49	0.70
Wages	0.96	0.74	0.82	0.85
Auctioneer	0.32	0.31	0.22	0.28
Utilities	0.16	0.16	0.12	0.15
Investment Cost	0.63	0.80	0.68	0.71
Depreciation	0.14	0.24	0.16	0.18
Insurance & Bonds	0.16	0.21	0.20	0.19
Taxes	0.29	0.20	0.21	0.24
Interest	0.04	0.15	0.11	0.10
Capital Improvement[c]	0.00	0.00	0.00	0.00
Operating Cost	0.53	0.48	0.39	0.47
Repairs & Maintenance	0.11	0.08	0.08	0.09
Office Supplies	0.17	0.11	0.13	0.14
Feed	0.02	0.05	0.01	0.03
Transportation & Gasoline	0.02	0.04	0.03	0.03
Market News Service	0.06	0.13	0.10	0.09
Lease Costs	0.15	0.07	0.04	0.09
Miscellaneous	0.48	0.42	0.29	0.40
TOTAL	4.70	3.83	3.59	4.09

[a]Source: Computed from data from the Annual Reports of Livestock Auction Markets to the West Virginia Department of Agriculture, 1967 and 1968. All values rounded.

[b]The number of observations in the 1 to 5,999 LMU, 6,000 to 11,999 LMU, and 12,000 LMU and over groups was 13, 11, and 11, respectively, except for the components of total labor costs. Not all reporting firms submitted a breakdown of these components. Twelve, nine, and ten firms, respectively, submitted the single figure of total labor costs; therefore, the group mean costs per LMU of the components of total labor cost will approach but not equal the group mean cost per LMU of all labor.

[c]The capital improvement cost for all groups averaged zero because only one firm in the population reported any capital improvement cost figure.

The quadratic equation (1) can be used to describe a cost unction which is consistent with economic theory; that is, one vhich decreases at a decreasing rate, reaches a minimum, and hen increases at an increasing rate. Equations (2) and (3) have symptotic characteristics; that is, they tend to flatten out as hey approach zero, but never reverse their slope. Equation (4), vhich incorporates the reciprocals of the independent variables of the quadratic equation (1), is an extension of equation (2).

The following significant equations (see appropriate analyes of variance of the multiple correlation coefficient in Appendix Table 6), were yielded, where Y_t refers to the aggregate average otal cost function:

1)

$$Y_t = \underset{(0.6357)^*}{509.72 - 1.8484X_1} + \underset{(0.0026)}{0.0054X_2}$$

$$R_2 = .75$$

2)

$$Y_t = 349.28 + \underset{(798.54)^{**}}{3114.50\ \left(\frac{1}{X_1}\right)}$$

$$R_2 = .72$$

3)

$$\log Y_t = \underset{(0.0365)^{**}}{2.8562 - 0.1355 \log X_1}$$

$$R_2 = .70$$

4)

$$Y_t = 321.55 + \underset{(3689.13)}{6747.02\ \left(\frac{1}{X_1}\right)} - \underset{(74559.38)}{75192.81\ \left(\frac{1}{X_2}\right)}$$

$$R_2 = .77$$

Again, standard errors of estimate are in parentheses below he corresponding partial regression coefficients. A double asterisk enotes significance at the .01 level; a single asterisk denotes ignificance at the .05 level.

The functions appropriate to these equations were plotted on he arithmetic scale graph in Figure 2. Equations (2), (3), and 4) appeared to conform well to economic theory. Other livestock uction cost studies have indicated that diseconomies of size are ot likely to occur over the size range discussed in this paper, and, herefore, the quadratic equation (1) could perhaps have been

TABLE 10

COST DATA FOR A DISTRIBUTION OF WEST VIRGINIA LIVESTOCK AUCTIONS INTO COMBINED SIZE CATEGORIES, 19 FIRMS IN 1967, 16 FIRMS IN 1968[a]

Group Interval (LMU's)	Number of Firms	Group Average Size (LMU's)	Group Average Total Costs
0-2,999	4	2,279	$10,694.57
3,000-4,999	7	3,696	17,116.66
5,000-6,999	4	6,087	25,680.72
7,000-8,999	4	7,882	27,301.83
9,000-10,999	4	10,221	42,012.30
11,000-12,999	5	12,077	44,032.77
13,000-14,999	5	13,731	49,508.81
15,000 and over	2	21,980	79,484.08

[a]Source: Derived from data in Tables 4 and 5.

excluded.[b] The curves in Figure 2 represent the costs per livestoc marketing unit associated with markets of different sizes. Sinc they do not necessarily imply full capacity utilization, they do n conform strictly to the theoretical concept of the long-run averag cost curve. The true long-run average cost curve would lie som where below the aggregate average total cost curve depicted i Figure 2, with its exact location depending on percentage cap city utilization of various sized plants. Nevertheless, the un cost-size relationship yielded in this study has direct relevance t West Virginia livestock auctions. The curves in Figure 2 exhib considerable unit cost advantages over their range. The mo marked decline in unit costs occurred in markets which handle up to 6,000 LMU's per year. Beyond this point, cost economi were not as great, though unit cost gains for markets in the 6,0 to 24,000 LMU range were in the order of 50 cents per LMU (a proximately 12 per cent) for total unit costs.

[b]Lindberg and Judge demonstrated declining average costs over a mark size range of 70,000 animal units (one animal unit equivalent to one horse, o head of cattle over 400 lbs., two calves 400 lbs. or less, two hogs, five shee R. C. Lindberg and G. G. Judge, **Estimated Cost Functions for Oklahoma Livesto Auctions**, Oklahoma Agricultural Experiment Station, Bulletin B-526 (Oklaho State University, January, 1958), p. 23. Wootan and McNeely demonstrated c economies over a market size range of up to over 190,000 animal units (one anin unit equivalent to one head of cattle, one hog, six sheep). Charles V. Wootan a John G. McNeely, **Factors Affecting Auction Market Operating Costs**, Texas Agr cultural Experiment Station, B-1056 (College Station, October, 1966), p. 28.

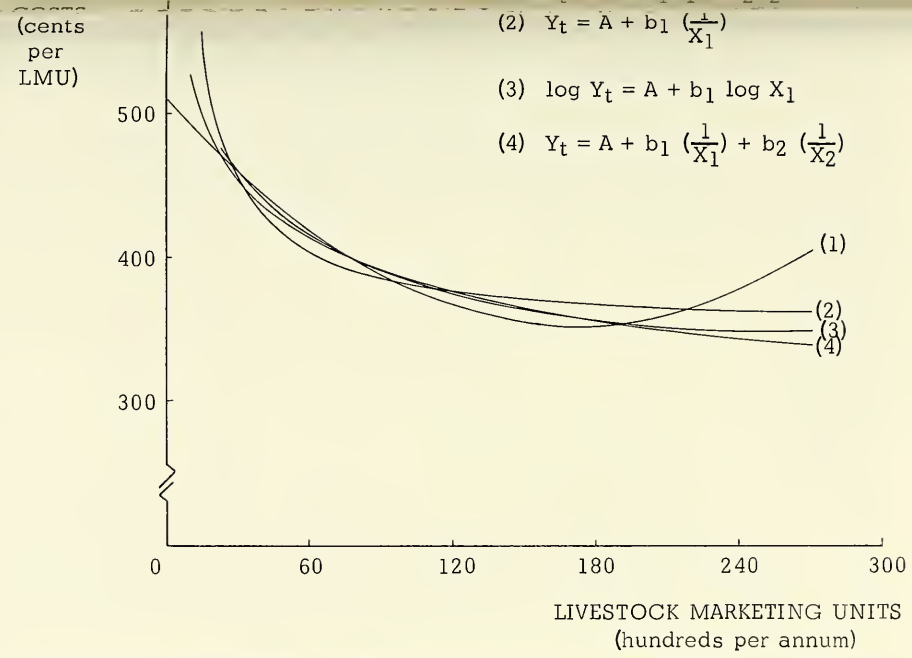

Figure 2. Unit cost curves for West Virginia livestock auctions, grouped size categories, 1967 and 1968 (regression equations computed from data in Table 10).

APPENDIX TABLE 1

WEST VIRGINIA LIVESTOCK AUCTION MARKETS, LOCATIONS AND SCHEDULED SALE DATES, 1968*

Name and Location of Market	Sale Day and Tim
Alderson Livestock Market	
Alderson	Monday 1:30 P.M.
Bluegrass Market, Inc.	
North Caldwell	Saturday 1:00 P.M.
Blue Ridge Livestock Sales, Inc.	
Charles Town	Monday 1:30 P.M.
Bridgeport Stockyards, Inc.	
Bridgeport	Monday 1:30 P.M.
Buckhannon Stockyards	
Buckhannon	Wednesday 1:30 P.M.
Evans Stockyards, Inc.	
Elkins	Thursday 1:30 P.M.
Gassaway Livestock Market, Inc.	
Gassaway	Monday 1:30 P.M.
Jackson County Livestock Market, Inc.	
Ripley	Thursday 1:30 P.M.
Mannington Livestock Sales Co., Inc.	
Mannington	Saturday 2:00 P.M.
Morgantown Livestock Sales, Inc.	
Morgantown	Wednesday 1:00 P.M.
Moundsville Livestock Auction Co.	
Moundsville	Monday 2:00 P.M.
New River Livestock Market	
Beckley	Wednesday 1:00 P.M.
Ohio County Livestock Auction, Inc.	
West Alexander, Pa.	Wednesday 2:30 P.M.
Pocahontas Producers Co-Op. Assn.	
Marlinton	Tuesday 1:30 P.M.
Point Pleasant Livestock Co.	
Point Pleasant	Saturday 1:00 P.M.
South Branch Stockyards, Inc.	
Moorefield	Wednesday 1:30 P.M.
Spencer Livestock Exchange Co.	
Spencer	Friday 1:00 P.M.
Terra Alta Stockyards, Inc.	
Terra Alta	Friday 1:30 P.M.
Union Livestock Sales Co., Inc.	
Parkersburg	Saturday 1:00 P.M.
Weston Livestock Sales Co., Inc.	
Weston	Tuesday 1:00 P.M.

*Source: J. Howard Myers (ed.), **West Virginia Blue Book** (Charleston: Jarrett Printing Company, 1968), LII, p. 891.

APPENDIX TABLE 2

EPLICA OF THE ANNUAL REPORT OF LIVESTOCK AUCTION MARKETS TO THE WEST VIRGINIA DEPARTMENT OF AGRICULTURE, 1967 AND 1968

Expenses During Year

Ending _____ 19—

Salaries.		_____
Officers and executives.	_____	
Other office salaries.	_____	
Management and supervision.	_____	
Auctioneer.	_____	
Wages paid.		_____
Operation.	_____	
Maintenance.	_____	
Stamps, stationery, and other office supplies.		_____
Feed.		_____
Transportation.		_____
Heat and fuel.		_____
Gasoline.		_____
Light and power.		_____
Water.		_____
Telephone.		_____
Telegraph.		
Market news service.		_____
Depreciation and depletion of operation equipment.		_____
Taxes.		_____
Interest.		_____
Insurance and bonds.		_____
Repairs on operating equipment.		_____
Repairs on building and land.		_____
Cost of capital improvement.		_____
Payments on notes and mortgages.[a]		_____
Cost of leases.		_____
Other cost. (list separately)		_____
_____		_____
_____		_____
_____		_____
TOTAL MARKET EXPENSES		_____

nce this item is not an expense, it was omitted from the analysis.

APPENDIX TABLE 3

TEST OF THE DIFFERENCE BETWEEN THE MEANS OF THE 1967 AND 1968 STUDY DATA

	Cattle	Calves	Hogs	Sheep and Lambs	Total Market Costs per Annum
Annual Mean 1967	6,156.26	3,733.68	2,845.42	5,906.42	$35,293.37
Annual Mean 1968	5,967.70	3,675.00	2,453.12	3,993.59	34,833.99
Difference	188.56	58.68	392.30	1,913.83	459.38
Standard Error of Difference	1,362.51	681.99	1,281.51	2,500.83	1,163.23
t-value*	0.138	0.086	0.306	0.765	0.064

*All values insignificant at the .05 level. (Critical value t $_{0.05,34 d.f.} = \pm 2.032$).

APPENDIX TABLE 4

ANALYSIS OF VARIANCE OF REGRESSION OF TOTAL MARKET COSTS ON NUMBERS OF MAJOR LIVESTOCK SPECIES HANDLED PER YEAR

$$Y = 1790.32 + 3.681X_1 + 1.289X_2 + 0.876X_3 + 0.769X_4$$

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Due to Regression	4	14,110,064,640	3,527,516,160	70.70**
Deviation from Regression	31	1,544,757,248	49,830,864	

**Denotes significance at the 1% level.

APPENDIX TABLE 5

REPLICA OF PART OF A TARIFF SHEET FOR A WEST VIRGINIA LIVESTOCK AUCTION[a]

SELLING COMMISSION AND YARDAGE

Cattle:		
1.	Steers, Heifers, & Bulls, 300 to 499 lbs.	$2.30 per head
2.	Steers, Heifers & Cows, 600 to 699 lbs.	$3.00 per head
3.	Steers, Heifers, & Cows, 700 and over	$3.25 per head
4.	Cows & Calves selling together	$4.25 per unit
Bulls:		
1.	500 lbs. to 599 lbs.	$3.00 per head
2.	600 to 799 lbs.	$3.25 per head
3.	800 lbs. and over	$4.50 per head
Calves:		
1.	Calves weighing under 300 lbs.	$1.75 per head
2.	Baby calves	$1.10 per head
Hogs:		
1.	Barrows & Gilts (sold by weight)	$1.00 per head
2.	Pigs & Shoats (100 lbs. or less)	$ .75 per head
3.	Boars (weighing over 250 lbs.)	$2.00 per head
4.	Sows and Pigs selling together	$3.00 per unit
Sheep and Goats:		
1.	One or more lambs, sheep, and goats	$ .60 per head
2.	Bucks	$1.10 per head

ource: Taken directly from a West Virginia auction tariff sheet (effective 1967). Excludes commission and yardage for horses, ponies, and mules. Excludes details of additional fees (sheep dipping, feed, and weighing).

APPENDIX TABLE 6

ANALYSIS OF VARIANCE OF REGRESSION OF COST PER LMU ON LMU'S HANDLED PER YEAR (WITH TRANSFORMATION OF DATA)*

$$Y_i = 509.72 - 1.8484X_1 + 0.0054X_2$$

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Due to Regression	2	12,395.566	6,197.781	7.661*
Deviation from Regression	5	4,045.285	809.057	

$$Y_i = 349.28 + 3{,}114.50 \left(\frac{1}{X_1}\right)$$

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Due to Regression	1	11,790.379	11,790.379	15.212**
Deviation from Regression	6	4,650.473	775.079	

$$\log Y_i = 2.8562 - 0.1355 \log X_1$$

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Due to Regression	1	0.013	0.013	13.753**
Deviation from Regression	6	0.006	0.001	

$$Y_i = 321.55 + 6747.02 \left(\frac{1}{X_1}\right) - 75192.81 \left(\frac{1}{X_2}\right)$$

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Due to Regression	2	12,576.445	6,288.223	8.136*
Deviation of Regression	5	3,864.405	772.881	

*Significance at the 1% level

**Significance at the 5% level

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